germination and the second with the appearance of the first flower. He believes that development is controlled during the earlier period mainly by air conditions, especially temperature, and during the second period mainly by soil conditions, especially water content. He regards as the limiting factor for growth what he terms "thermotoxy"—the supposed accumulation of injurious products of metabolism caused by high temperatures and aggravated by a deficient water supply. Varietal differences in length of the growth period would indicate corresponding differences in resistance to "thermotoxy." Experiments are described which deal with the effect of a high water table in checking root development and in inducing shedding of the flower buds. This subject is at present much discussed in Egypt in connection with the recognized deterioration of the cotton crop.

In the field of genetics fluctuation, natural crossing and heredity are treated. Much space is devoted to the application of Mendelian and post-Mendelian principles to cotton hybrids. This discussion, interesting and suggestive though it be, will scarcely inspire the cotton breeder with confidence that his practical problems will be speedily solved by the Mendelists.

By way of criticism, attention may be called to a certain lack of balance in the space devoted to different phases of the subject. Thus the morphology of the vegetative organs, which is of great interest agriculturally as well as botanically, receives but scant notice. One reads with astonishment that there is "apparent identity of all the modern varieties of Egyptian cotton in external appearance—for, even when grown side by side, they are scarcely distinguishable." Several of the varieties, when grown in Arizona from imported seed, have proven readily distinguishable by the characters of the leaves, bracts and bolls. There is also a tendency to put forth rather sweeping generalizations. Such are the assumptions, regarding fluctuation, that in a pure strain it "is the result of slight irregularities in a normally uniform environment" (p. 89) and that "physiology explains it" (p. 90). It is also not very clear to the uninitiated why transmitting power "is not a mysterious vital function" merely because it "can be reduced to formulæ." Several of the text figures are left without satisfactory explanation, either in the legends or in the text, and the reader would be saved time and trouble if the pages were cited in referring to the figures.

Nevertheless this little volume can not fail to be helpful and suggestive to all investigators of the cotton plant and not its least valuable mission is to show some of the ways by which scientific investigation of a crop plant may be brought to bear in improving agricultural practise.

T. H. K.

Naturwissenschaftliche Studien am Toten Meer und im Jordantal. Von Professor Dr. MAX BLANCKENHORN. Berlin. 478 pages with geographical map and table.

Students of the geology of Palestine probably owe more to Dr. Max Blanckenhorn than to any other one author. The present volume is an account of his last expedition undertaken in 1908 at the request of the Turkish government. The ex-sultan, Abdul Hamid II., apparently desired to discover mineral wealth in the valley of the Jordan River and Dead Sea, which is his private property. Dr. Blackenhorn, however, wisely insisted that the expedition should be primarily scientific, and not economic. The results justify his position, for Palestine is very poor in mineral wealth. Pure science, however, did not satisfy the Turkish government which still, in spite of repeated promises, owes Dr. Blanckenhorn twenty-five hundred dollars for expenses incurred at their request.

Dr. Blanckenhorn's work divides itself into three closely related parts, economic, geologic and physiographic. In respect to the first two we accept his results without question, but as to the third there is some doubt. Inasmuch as the geological formations of Palestine are almost entirely cretaceous, little mineral wealth is to be expected. The salt deposits of Jebel Usdum at the south end of the Dead

Sea would have some value if they were not so inaccessible. The same is true to a greater extent of the phosphatic rocks of cretaceous age which the author describes near Nebi Musa, east of Jerusalem, and near Es-Salt, in Moab, east of the Jordan. These latter deposits are estimated to have a market value of nearly a million and a half dollars, and perhaps much more. Nevertheless, an English company, after spending $20,000 in prospecting, abandoned its enterprise, because the deposits are so remote, and because the directors of the Mecca railway imposed such onerous conditions of carriage. The only other valuable mineral product is asphalt, with which the cretaceous strata are largely impregnated, but the quality is not high, and the arid climate, rough topography and distance from the railroad prevent its exploitation at present. In discussing all these formations —salt, phosphates and asphalt—the author's geological observations are of more value than purely economic considerations.

Throughout the volume Dr. Blackenhorn devotes himself mainly to strict geology. Unfortunately he has adopted the style of a diary in which his birthday, his bath, Turkish officials and the weather are mixed up with a great mass of minute geological details. These details are arranged according to the chance order in which he happened to see them, and hence are difficult to follow and to interpret in general terms. They serve, however, as a running commentary upon two highly valuable contributions, namely, an admirable and reliable geological map, a large part of which is Dr. Blanckenhorn's own work, and a table which sums up the pliocene and pleistocene history of Palestine. The portions of this table based upon physiographic evidence are the part of the volume open to question. A summary of late geological history as interpreted by Dr. Blanckenhorn is as follows:

Lower Pliocene, or late Miocene. Low stand of Mediterranean Sea. First upheaval of the highlands of Palestine, accompanied by east–west, or N.W.–S.E. faulting which gave rise to such features as the separation of Upper and Lower Galilee, the basin of Asochis in southern Galilee, and the fault-scarp and plain of Esdrælon between Galilee and Samaria.

Upper Pliocene. Broad encroachment of sea in Syrian Desert. Small lakes occupying parts of the present area of the Sea of Galilee. Basaltic lava flows of Banias and el-Markab. Completion of first great erosion-phase of rivers.

Gunz Glacial Epoch. Level of Mediterranean Sea 330 meters higher than now. At the beginning of this epoch the depression occupied by the Jordan Valley, Dead Sea, Gulf of Akaba and Red Sea began to take form, while at the end occurred the great movements which gave final form to the deeply depressed graben in which lie these various bodies of water. With this went considerable faulting in a N.E., S.W. as well as N. and S. direction. Conglomerates and marls were deposited in the much-expanded predecessor of the Dead Sea.

Gunz-Mindel Interglacial Epoch. This was a short dry period during which the Dead Sea contracted so far that the thick salt beds of Jebel-Usdum were deposited.

Mindel Glacial Epoch. Sea 33 to 80 meters higher than now. Culmination of glacial period with small glacier in Lebanon. Highest stand of Dead Sea, which extended from the Sea of Galilee to Wadi Araba. The strand formed at this time is supposed by Blanckenhorn to be represented by what he calls the Haupt Terrasse or Terrace of Jericho. In the Jordan Valley he assigns to this a height of 100 to 200 meters above the present level of the Dead Sea, at the north end of the Dead Sea a height of 50 meters, and at the south end a height of 486 meters. His natural inference is that there has been an unequal upheaval at the north and south, and a sinking in the middle. It seems impossible to accept this view, since, as the reviewer has shown in "Palestine and its Transformation," there are terraces at the north end of the Dead Sea much higher than 50 meters; and near the head of Wadi Kuram, in this same region, between Massaba and Nebi Musa, deposits, apparently of lacustrine origin, are found at a height of approximately 450 meters.

Mindel-Riss Interglacial Epoch. A long, dry period during which the Dead Sea fell to approximately the present level. Great erosion and much outpouring of lava.

Riss Glacial Epoch. Slight encroachment of the Mediterranean Sea, many lava flows. Slight expansion of the Dead Sea, formation of the

"middle terrace" in the deltas of various wadis. On physiographic grounds it seems to the reviewer open to question whether this terrace should be put at this time or much later.

Riss-Würm or last Interglacial Epoch. Mediterranean Sea at present level, climate approaching that of to-day.

Würm Glacial Epoch. No notable expansion of the Dead Sea. Formation of lowest terrace of the valleys, a conclusion which is open to question.

Post-Glacial Epoch. Uniform prevalence of conditions like those of to-day.

In the interpretation of rock geology, Dr. Blackenhorn is an expert, but when it comes to the interpretation of such physiographic phenomena as strands and terraces we are unable to accept his conclusions. In the first place he has failed to observe a large number of lacustrine strands which close study reveals at many points and at many altitudes around the Dead Sea. In the second place, he seems to have confused lacustrine and alluvial terraces in various places, and in the third place he has correlated terraces which apparently have no relation to one another. For instance, on page 139, when describing the Araba south of the Dead Sea, he describes a "Haupt Terrasse" with a height of 4 meters and a "Mittel Terrasse" with a height of one meter. The first of these terraces is assumed to have existed ever since the Mindel glacial epoch, and is correlated with a terrace which elsewhere is 150 meters high. He supposes the middle terrace to have originated during the Riis Glacial Epoch, and to have survived the vicissitudes of the Riis-Würm Interglacial Epoch, the Würm glacial epoch, and the succeeding period during which the climate is supposed to have remained in its present condition. Both of these terraces, it must be remembered, are in unconsolidated gravelly alluvium. It seems to the reviewer that they probably are the result of late post-glacial climatic pulsations.

In view of the diversity of results obtained by Dr. Blackenhorn and by other observers the whole question of the history of the Dead Sea from tertiary times onward needs a far more thorough and systematic examination than it has yet received. This is the more necessary since the Dead Sea and Jordan Valley contain one of the best of all records of the Pleistocene history of the drier portions of the world. Dr. Blackenhorn's excellent study of the fundamental rock structure of the region is an admirable basis for such an examination. It is to be hoped that a further step may soon be taken and that by means of a careful instrumental survey of the old strands, terraces and deposits, the physical history of the region during the last hundred thousand years or so may be conclusively determined.

ELLSWORTH HUNTINGTON

SPECIAL ARTICLES

THE PERFECT STAGE OF CYLINDOSPORIUM ON PRUNUS AVIUM

IN the fall of 1910, at the suggestion of Professor George F. Atkinson, the writer began a study of *Cylindrosporium,* as it occurs on species of *Prunus* in the region of Ithaca, N. Y., in order to discover the life history, and the relationship of the organism on the different hosts.

Several sweet cherry trees, which had been severely attacked by *Cylindrosporium* during the previous summer, were noted and the fallen leaves observed at intervals for the appearance of an ascogenous fungus. Early in March developing fruit bodies were noticed in abundance on many leaves, some of which were brought into the laboratory and placed in a moist chamber. After a few days at the room temperature of the laboratory many of the fruit bodies showed mature asci.

Subsequent observations showed that a stroma begins to develop under the *Cylindrosporium acervuli* about the last of August. About the time of leaf fall the acervulus is cut off from the underlying stroma by a compact layer of host tissue two or three cells thick, of thick-walled cells which surrounds the whole stroma and very soon turns black. Slow internal development of this stroma continues during the winter; and by the first of May mature asci and ascospores may be found.